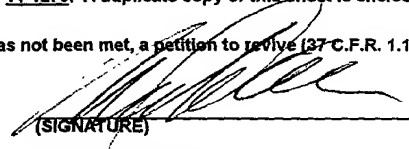


FORM PTO-1390 U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371		ATTORNEY'S DOCKET NO. PHN 17.510 U.S. Application No. (if known, see 37 CFR 1.5) <div style="font-size: 1.5em; font-weight: bold;">09/763843</div>
INTERNATIONAL APPLICATION NO. PCT/EP00/05906	INTERNATIONAL FILING DATE JUNE 26, 2000	PRIORITY DATE CLAIMED JUNE 29, 1999
TITLE OF INVENTION CDMA COMMUNICATION SYSTEM		
APPLICANT(S) FOR DO/EO/US WILHELMUS JOHANNES VAN HOUTUM, CAREL JAN LEENDERT VAN DRIEL		
Applicant(s) herewith submit to the United States Designated/Elected Office (DO/EO/US) the following items and other information:		
1. <input checked="" type="checkbox"/> This is a FIRST submission of items concerning a filing under 35 U.S.C. 371. 2. <input type="checkbox"/> This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371. 3. <input type="checkbox"/> This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1). 4. <input type="checkbox"/> A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date. 5. <input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371 (c)(2)) a. <input checked="" type="checkbox"/> is transmitted herewith (required only if not transmitted by the International Bureau). b. <input type="checkbox"/> has been transmitted by the International Bureau. c. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US). 6. <input type="checkbox"/> A translation of the International Application into English (35 U.S.C. 371(c)(2)) 7. <input checked="" type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3)) a. <input type="checkbox"/> are transmitted herewith (required only if not transmitted by the International Bureau). b. <input type="checkbox"/> have been transmitted by the International Bureau. c. <input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired. d. <input checked="" type="checkbox"/> have not been made and will not be made. 8. <input type="checkbox"/> A translation of the amendment to the claims under PCT Article 19 (35 U.S.C. 371 (c)(3)). 9. <input checked="" type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)). 10. <input type="checkbox"/> A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)). Items 11. to 16. Below concern document(s) or information included: 11. <input checked="" type="checkbox"/> An Information Disclosure Statement under 37 C.F.R. 1.97 and 1.98. 12. <input checked="" type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 C.F.R. 3.28 and 3.31 is included. 13. <input type="checkbox"/> A FIRST preliminary amendment. <input type="checkbox"/> A SECOND OR SUBSEQUENT preliminary amendment. 14. <input type="checkbox"/> A substitute specification. 15. <input checked="" type="checkbox"/> A change of power of attorney and/or address letter. 16. <input checked="" type="checkbox"/> Other items or information: 2 SHEETS OF DRAWINGS CHARGE AUTHORIZATION		
CERTIFICATE OF EXPRESS MAILING Express Mail Mailing Label No. <u>EL 297132342</u> Date of Deposit <u>February 27, 2001</u> I hereby certify that this paper and/or fee is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 C.F.R. 1.10 on the date indicated above and is addressed to the Commissioner of Patents and Trademarks, Washington D.C. 20231 <div style="display: flex; justify-content: space-between;"> <u>Valerie Deas</u> Typed Name <u>Valerie Deas</u> Signature </div>		

U.S. APPLICATION NO. (If known, see 37 C.F.R. 1.5) 09/763843		INTERNATIONAL APPLICATION NO. PCT/EP00/05906		ATTORNEY'S DOCKET NUMBER PHN 17,510	
17 <input type="checkbox"/> The following fees are submitted: BASIC NATIONAL FEE (37 C.F.R. 1.492(A)(1)-(5)): Search Report has been prepared by the EPO or JPO \$940.00 International preliminary-examination fee paid to USPTO \$720.00 (37 C.F.R. 1.482) No international preliminary examination fee paid to USPTO \$760.00 (37 C.F.R. 1.482) but international search fee paid to USPTO (37 C.F.R. 1.445(a)(2)) Neither international preliminary examination fee (37 C.F.R. 1.482) nor international search fee (37 C.F.R. 1.445(a)(2)) \$970.00 paid to USPTO International preliminary examination fee paid to USPTO \$ 96.00 (37 C.F.R. 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4) ENTER APPROPRIATE BASIC FEE AMOUNT = \$970.00				CALCULATIONS (PTO USE ONLY)	
Surcharge of \$130.00 for furnishing the oath or declaration later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 C.F.R. 1.492(e)).				\$	
CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total Claims	9 - 20 =	0	X \$ 18.00	\$	
Independent claims	3 - 3 =	0	X \$ 78.00	\$	
MULTIPLE DEPENDENT CLAIMS (if applicable)			+ \$260.00	\$	
TOTAL OF ABOVE CALCULATIONS =				\$970.00	
Reductions by 1/2 for filing by small entity, if applicable. Verified Small Entity Statement must also be filed (Note 37 C.F.R. 1.9, 1.27, 1.28)				\$	
SUBTOTAL =				\$	
Processing fee of \$130.00 for furnishing the English translation later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 C.F.R. 1.492(f)).				\$	
TOTAL NATIONAL FEE =				\$	
Fee for recording the enclosed assignment (37 C.F.R. 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 C.F.R. 3.28, 3.31). \$40.00 per property				+ \$40.00	
TOTAL FEES ENCLOSED =				\$1010	
				Amount to be Refunded	\$
				Charged	\$
a. <input type="checkbox"/> A check in the amount \$_____ to cover the above fees is enclosed. b. <input checked="" type="checkbox"/> Please charge my Deposit Account No. <u>14-1270</u> in the amount of <u>\$1,010.00</u> to cover the above fees. A duplicate copy of this sheet is enclosed. c. <input checked="" type="checkbox"/> The Commissioner is hereby authorized to charge any additional fee, with the exception of the Base Issue Fee, which may be required, or credit any overpayment to Deposit Account No. <u>14-1270</u> . A duplicate copy of this sheet is enclosed.					
NOTE: Where an appropriate time limit under 37 C.F.R. 1.494 or 1.495 has not been met, a petition to revive (37 C.F.R. 1.137(a) or (b)) must be filed and granted to restore the application to pending status.					
SEND ALL CORRESPONDENCE TO: Corporate Patent Counsel Philips Electronics North America Corporation 580 White Plains Road Tarrytown, NY 10591					
(SIGNATURE)  MICHAEL E. MARION (NAME)					
32,266 (REGISTRATION NUMBER)					

CDMA communication system.

The invention relates to a CDMA communication system comprising at least one primary station and a plurality of secondary stations, the primary station and the secondary stations exchanging CDMA signals via a communication medium, the secondary stations each comprising a modulator for modulating a respective data signal with a respective code word in order to obtain a respective CDMA signal, the modulator being embodied so as to modulate the respective data signal with an initial code word until synchronisation with the primary station is obtained, the modulator being further embodied so as to modulate the respective data signal with a respective final code word after synchronisation with the primary station has been obtained.

The invention further relates to a secondary station for exchanging CDMA signals via a communication medium with at least one primary station and to a method of synchronising a secondary station with a primary station.

A CDMA communication system according to the preamble is known from United States Patent Number 5 499 236. Code Division Multiple Access (CDMA) is a multiplexing technique which permits a number of users to simultaneously access a transmission channel. For this purpose a data signal to be transmitted is modulated with a code word, i.e. a pseudorandom binary sequence, in order to spread the spectrum of the waveform. In a receiver the original data signal can be detected by correlating the received CDMA signal with the corresponding code word. This correlation despreads the spectrum. Other CDMA signals are not despread by the correlator because their code words do not match. CDMA can be used, for example, in mobile communication systems and in interactive cable television networks.

The system capacity, i.e. the total sum of the bit rates of the users, of a synchronised CDMA communication system is limited by the maximum number of different code words, whereas the system capacity of an asynchronous CDMA communication system is limited by the interference noise. Hence, the system capacity of a synchronised CDMA

communication system is generally much higher than that of an asynchronous CDMA communication system.

In the known synchronised CDMA communication system all secondary stations which are not yet synchronised with the primary station and which want to transmit data to that primary station use the same initial code word to modulate their data signals with. Next, the resulting asynchronous CDMA signals are transmitted to the primary station. The primary station then determines for each secondary station the timing difference between the received CDMA signal and a reference clock and transmits this timing difference to each particular secondary station. Next, the secondary stations can synchronise with the primary station by time shifting the initial code word in accordance with the received timing differences. This process is repeated for each secondary station until synchronisation is obtained, after which a different final code word is used by each secondary station to modulate its data signal with.

In the known CDMA communication system the asynchronous use of the initial code word may cause interference with the CDMA signals received and transmitted by the already synchronised secondary stations.

An object of the invention is to provide a CDMA communication system, wherein the asynchronous use of the initial code word does not cause interference with the CDMA signals received and transmitted by the already synchronised secondary stations. This object is achieved in the CDMA communication system according to the invention, which is characterized in that the initial code word is substantially orthogonal to the final code words for every possible time shift of the initial code word. The invention is based upon the recognition that such an initial code word does not interfere with the CDMA signals received and transmitted by the already synchronised secondary stations and is therefore very well suited for the purpose of synchronising a secondary station with the primary station.

A first embodiment of the CDMA communication system according to the invention is characterized in that all symbol values of the initial code word are equal to each other. If all symbol values of an initial code word are equal to each other, that initial code word remains the same for every possible time shift of that initial code word. Hence, a time shift of that initial code word does not influence the orthogonality of that initial code word relative to the final code words.

A second embodiment of the CDMA communication system according to the invention is characterized in that the code words are Walsh-Hadamard codes and that the initial code word corresponds to the first row or the first column of the Walsh-Hadamard matrix. Walsh-Hadamard code words have ideal cross correlation properties because all the Walsh-Hadamard code words are mutually orthogonal. The system capacity of a synchronised CDMA communication system can be further increased by using Walsh-Hadamard code words. If Walsh-Hadamard codes are used as code words the code corresponding to the first row or the first column of the Walsh-Hadamard matrix is an ideal initial code word as it is, for every possible time shift of that code, substantially orthogonal to all the final Walsh-Hadamard code words in use by the already synchronised secondary stations.

The above object and features of the present invention will be more apparent from the following description of the preferred embodiments with reference to the drawings, wherein:

Figure 1 shows a block diagram of an embodiment of a CDMA communication system according to the invention,

Figure 2 shows a block diagram of part of an embodiment of a secondary station,

Figure 3 shows a Walsh-Hadamard matrix H_4 .

Figure 1 shows a block diagram of an embodiment of a CDMA communication system according to the invention. In such a CDMA communication system CDMA signals are exchanged via a communication medium 6 between a number of stations 2 and 4. These CDMA communication stations 2 and 4 comprise at least one primary station 2, which is here a head end, and a plurality of secondary stations 4. The CDMA communication system, which may comprise further primary stations 2 and secondary stations 4, is a partly synchronised CDMA communication system. This means that some of the secondary stations 4 are synchronised to the primary station 2, while other secondary stations 4 are not yet synchronised to the primary station 2.

Figure 2 shows a block diagram of a part of a secondary station 4. The part that is shown is that relating to the modulation of an input data signal 16. Operational parameters of all blocks shown are controlled by a controller (not shown). The secondary stations 4 each

comprise a modulator 10 for modulating the input data signals 16 with code words 14 in order to obtain the CDMA signals 18. These code words 14 may be generated by a generator 12. A modulator 10 of a secondary station 4 which is not yet synchronised to the primary station 2 initially modulates its data signal 16 with an initial code word 14 until that secondary station 4 is synchronised with the primary station 2. From that moment on the data signal 16 is modulated with a final code word 14.

Ideally, an initial code word 14 is used which is, for every possible time shift of that code, substantially orthogonal to all the final code words 14 in use by the already synchronised secondary stations 4. Such an initial code word does not interfere with the CDMA signals 18 received and transmitted by the already synchronised secondary stations 4 and is therefore very well suited for the purpose of synchronising a secondary station 4 with the primary station 2. Code words 14 which have symbol values which are all equal to each other are such ideal initial code words. If all symbol values of an initial code word are equal to each other, that initial code word remains the same for every possible time shift of that initial code word. Hence, a time shift of that initial code word does not influence the orthogonality of that initial code word relative to the final code words. If Walsh-Hadamard codes are used as code words 14 the code word corresponding to the first row or the first column of the Walsh-Hadamard matrix is a practical example of an ideal initial code word having symbol values which are all equal to each other.

Figure 3 shows a Walsh-Hadamard matrix H_4 . A Walsh-Hadamard matrix H_n is defined inductively and can be calculated from a given Walsh-Hadamard matrix H_1 . The rows $R_0..R_{2^n-1}$ and columns $C_0..C_{2^n-1}$ of a Walsh-Hadamard matrix H_n are orthogonal. The code words 14 may be based on the rows $R_0..R_{2^n-1}$ or the columns $C_0..C_{2^n-1}$ of such a Walsh-Hadamard matrix H_n . A code word based upon the first row R_0 or the first column C_0 of the Walsh-Hadamard matrix H_4 (in general: of the Walsh-Hadamard matrix H_n) has symbol values which are all equal to each other.

The scope of the invention is not limited to the embodiments explicitly disclosed. The invention is embodied in each new characteristic and each combination of characteristics. Any reference signs do not limit the scope of the claims. The word "comprising" does not exclude the presence of other elements or steps than those listed in a claim. Use of the word "a" or "an" preceding an element does not exclude the presence of a plurality of such elements.

CLAIMS:

1. A CDMA communication system comprising at least one primary station (2) and a plurality of secondary stations (4), the primary station (2) and the secondary stations (4) exchanging CDMA signals (18) via a communication medium (6), the secondary stations (4) each comprising a modulator (10) for modulating a respective data signal (16) with a
5 respective code word (14) in order to obtain a respective CDMA signal (18), the modulator (10) being embodied so as to modulate the respective data signal (16) with an initial code word until synchronisation with the primary station (2) is obtained, the modulator (10) being further embodied so as to modulate the respective data signal (16) with a respective final code word after synchronisation with the primary station (2) has been obtained, characterized in that
10 the initial code word is substantially orthogonal to the final code words for every possible time shift of the initial code word.

2. A CDMA communication system according to Claim 1, characterized in that all symbol values of the initial code word are equal to each other.

3. A CDMA communication system according to Claim 1 or 2, characterized in that the code words (14) are Walsh-Hadamard codes and that the initial code word corresponds to the first row or the first column of the Walsh-Hadamard matrix.

4. A secondary station (4) for exchanging CDMA signals (18) via a communication medium (6) with at least one primary station (2), the secondary station (4) comprising a modulator (10) for modulating a data signal (16) with a code word (14) in order to obtain a CDMA signal (18), the modulator (10) being embodied so as to modulate the data signal (16) with an initial code word until synchronisation with the primary station (2) is
20 obtained, the modulator (10) being further embodied so as to modulate the data signal (16) with a final code word after synchronisation with the primary station (2) has been obtained, characterized in that the initial code word is substantially orthogonal to the final code word for every possible time shift of the initial code word.

5. A secondary station (4) according to Claim 4, characterized in that all symbol values of the initial code word are equal to each other.

6. A secondary station (4) according to Claim 4 or 5, characterized in that the code words (14) are Walsh-Hadamard codes and that the initial code word corresponds to the first row or the first column of the Walsh-Hadamard matrix.

7. A method of synchronising a secondary station (4) with a primary station (2), the primary station (2) and the secondary station (4) exchanging CDMA signals (18) via a communication medium (6), the method comprising the steps of:

- modulating a data signal (16) with an initial code word (14) in order to obtain an initial CDMA signal (18) and transmitting the initial CDMA signal (18) to the primary station (2) until synchronisation with the primary station (2) is obtained,

- modulating the data signal (16) with a final code word (14) in order to obtain a final CDMA signal (18) and transmitting the final CDMA signal (18) after synchronisation with the primary station (2) has been obtained,

characterized in that the initial code word is substantially orthogonal to the final code word for every possible time shift of the initial code word.

8. A method of synchronising a secondary station (4) with a primary station (2) according to Claim 7, characterized in that all symbol values of the initial code word are equal to each other.

9. A method of synchronising a secondary (4) station with a primary station (2) according to Claim 7 or 8, characterized in that the code words (14) are Walsh-Hadamard codes and that the initial code word corresponds to the first row or the first column of the Walsh-Hadamard matrix.

ABSTRACT:

The CDMA communication system according to the invention comprises at least one primary station (2) and a plurality of secondary stations (4). The primary station (2) and the secondary stations (4) can exchange CDMA signals (18) via a communication medium (6). The secondary stations (4) each comprise a modulator (10) for modulating data signals (16) with code words (14) in order to obtain the CDMA signals (18). A modulator (10) of a secondary station (4) initially modulates its data signal (16) with an initial code word until that secondary station (4) is synchronised with the primary station (2). From that moment on the data signal (16) is modulated with a final code word. Ideally, an initial code word is used which is, for every possible time shift of that code, substantially orthogonal to all the final code words in use by the already synchronised secondary stations (4). Such an initial code word does not interfere with the CDMA signals (18) received and transmitted by the already synchronised secondary stations (4) and is therefore very well suited for the purpose of synchronising a secondary station (4) with the primary station (2). If Walsh-Hadamard codes are used as code words the code word corresponding to the first row of the Walsh-Hadamard matrix is an example of such an ideal initial code word.

Fig. 1

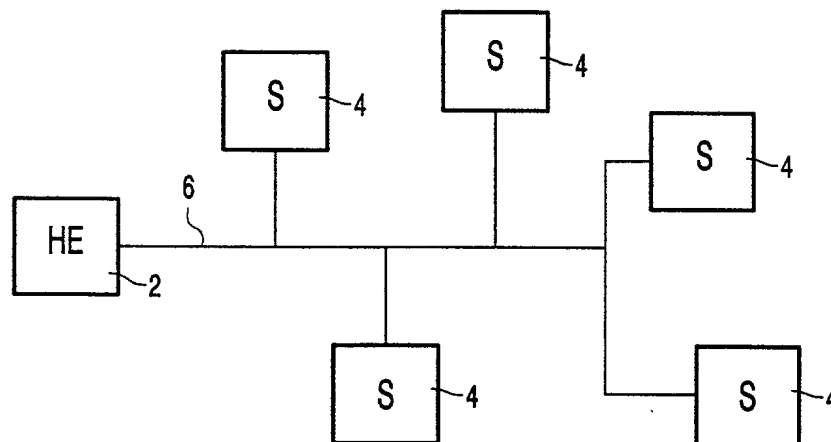


FIG. 1

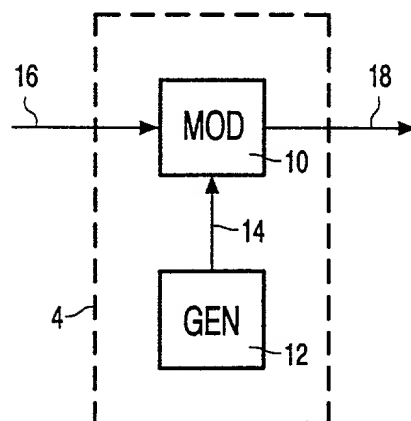


FIG. 2

C_0	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	R_0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R_0
0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	R_1
0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1	R_2
0	1	1	0	0	1	1	0	0	1	1	0	0	1	1	0	R_3
0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1	R_4
0	1	0	1	1	0	1	0	0	1	0	1	1	0	1	0	R_5
0	0	1	1	1	1	0	0	0	0	1	1	1	1	0	0	R_6
0	1	1	0	1	0	0	1	0	1	1	0	1	0	0	1	R_7
0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	R_8
0	1	0	1	0	1	0	1	1	0	1	0	1	0	1	0	R_9
0	0	1	1	0	0	1	1	1	1	0	0	1	1	0	0	R_{10}
0	1	1	0	0	1	1	0	1	0	0	1	1	0	0	1	R_{11}
0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	R_{12}
0	1	0	1	1	0	1	0	1	0	1	0	0	1	0	1	R_{13}
0	0	1	1	1	1	0	0	1	1	0	0	0	0	1	1	R_{14}
0	1	1	0	1	0	0	1	1	0	0	1	0	1	1	0	R_{15}

FIG. 3

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled: **"CDMA communication system"**

the specification of which (check only one item below):

☐ is attached hereto.

☐ was filed as United States application

Serial No _____

on _____

and was amended

on _____

☒ was filed as PCT international application

Number PCT/EP00/05906

on 26 June 2000

and was amended under PCT Article 19

(if applicable).

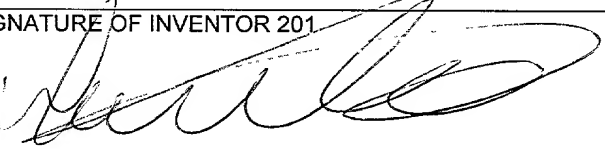

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, § 1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, § 119 of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed:

PRIOR FOREIGN/PCT APPLICATION(S) AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. 119:

COUNTRY	APPLICATION NUMBER	DATE OF FILING DAY, MONTH, YEAR	PRIORITY CLAIMED UNDER 35 USC 119
Europe	99202096.6	29 June 1999	YES

Combined Declaration For Patent Application and Power of Attorney (Continued) (includes Reference to PCT International Applications)				Attorneys Docket Number PHN 17.510 US	
POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. (List name and registration number)					
Algy Tamoshunas Reg. No. <u>27,677</u> Jack E. Haken, Reg. No. <u>26,902</u>				Direct Telephone Calls to: (name and telephone number) (914)332-0222	
201	FULL NAME OF INVENTOR	FAMILY NAME <u>VAN HOUTUM</u>	FIRST GIVEN NAME <u>Wilhelmus</u>	SECONDE GIVEN NAME <u>Johannes</u>	
	RESIDENCE & CITIZENSHIP	CITY <u>Eindhoven</u>	STATE OR FOREIGN COUNTRY <u>The Netherlands</u>	COUNTRY OF CITIZENSHIP <u>The Netherlands</u>	
	POST OFFICE ADDRESS	POST OFFICE ADDRESS <u>Prof. Holstlaan 6</u>	CITY <u>5656 AA Eindhoven</u>	STATE & ZIP CODE/COUNTRY <u>The Netherlands</u>	
202	FULL NAME OF INVENTOR	FAMILY NAME <u>VAN DRIEL</u>	FIRST GIVEN NAME <u>Carel</u>	SECONDE GIVEN NAME <u>Jan Leendert</u>	
	RESIDENCE & CITIZENSHIP	CITY <u>Eindhoven</u>	STATE OR FOREIGN COUNTRY <u>The Netherlands</u>	COUNTRY OF CITIZENSHIP <u>The Netherlands</u>	
	POST OFFICE ADDRESS	POST OFFICE ADDRESS <u>Prof. Holstlaan 6</u>	CITY <u>5656 AA Eindhoven</u>	STATE & ZIP CODE/COUNTRY <u>The Netherlands</u>	
I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.					
SIGNATURE OF INVENTOR 201 			SIGNATURE OF INVENTOR 202 		
DATE 18 January 2001			DATE 18 January 2001		

U.S. DEPARTMENT OF COMMERCE- Patent and Trademarks Office
(July 1994)